NESTS Transit Planning Project

Task 2 Deliverable:

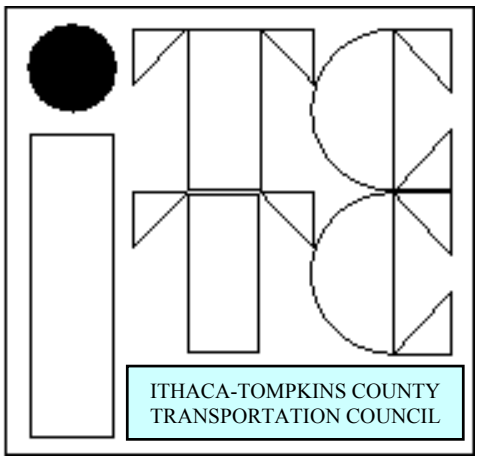
Service and Facility Strategies

MULTISYSTEMS

· with ·

Creighton Manning Engineering

Ithaca-Tompkins County Transportation Council



August, 2002

1.0 Background

The NESTS Transit Planning Project is a study primarily concerned with designing an enhanced transit system that would encourage people to shift from driving automobiles to using transit. For purposes of this memorandum, the study area has been divided into two portions, the southern portion and the northern portion. The southern portion extends northward from Downtown Ithaca and Cornell University to Pyramid Mall. The northern portion extends northward from Pyramid Mall and includes the town and village of Lansing.

Section 2 in this memorandum details the proposed route changes and considers the impact of various levels of service. Section 3 considers facilities and the application of technology to improve the riders' experience and increase operational efficiency. Sections 4 and 5 estimate operating cost and ridership impacts of the proposed service changes. Finally, Section 6 estimates the capital costs associated with the service and facility concepts.

2.0 Service Strategies

To encourage drivers to leave their cars and use public transit, improved routes and services are proposed. These service strategies include new routes, improved service on current routes, and improved connections between routes.

New routes were developed to serve areas that are not currently served, to offer faster and more direct service between locations, and to make pick-ups and drop-offs more convenient. Current routes would be improved by expanding service hours on weekday evenings and weekends, and by increasing the frequency of service (i.e., decreasing the amount of time one must wait for a bus to arrive). Both of these improvements were cited by respondents to the telephone survey conducted in task 1 of this study as being among the most strongly desired. The construction and operation of a suburban transfer facility (Pyramid transit hub) would improve connections between routes by providing a convenient, safe, and high visibility location for passengers to transfer between routes and services. The schedules of routes serving this hub would be coordinated to reduce waiting time to a minimum.

Public input offered guidance as the various service strategies were developed. Information gathered from local officials, employers, the project committee and the general public was combined with route and segment-level ridership data, travel patterns, on-site local research, and data from the telephone survey conducted in task 1 to develop, and then to fine-tune, the proposed strategies.

Section 2.1 details the proposed service concepts in the southern portion of the NESTS area. Section 2.2 describes the proposed concepts in the northern portion. The suburban transfer facility is a key component of the service strategies. It would be constructed and operated near Pyramid Mall. Additional information about the proposed Pyramid transit hub is described in Section 2.3 and Section 3.1. Section 2.4 discusses three possible levels of service at which the proposed route structure can be operated. Section 2.5 mentions other possible service changes not yet analyzed.

2.1 Changes in the Southern Portion of the NESTS Area

There are many potential service changes throughout the southern portion of the study area, including several new routes and major route modifications. The proposed service concepts include the following:

- New routes
  - Express Routes (A and B)
  - Mall Area Circulators (Long and Short)
  - Downtown Area Circulators (A and B)

- Significant Route Modifications
  - Route 31
  - Route 32
  - Route 35
  - Route 37

- Slight Route Modifications
  - Route 16
  - Route 36
  - Route 40
  - Route 41
  - Route 43

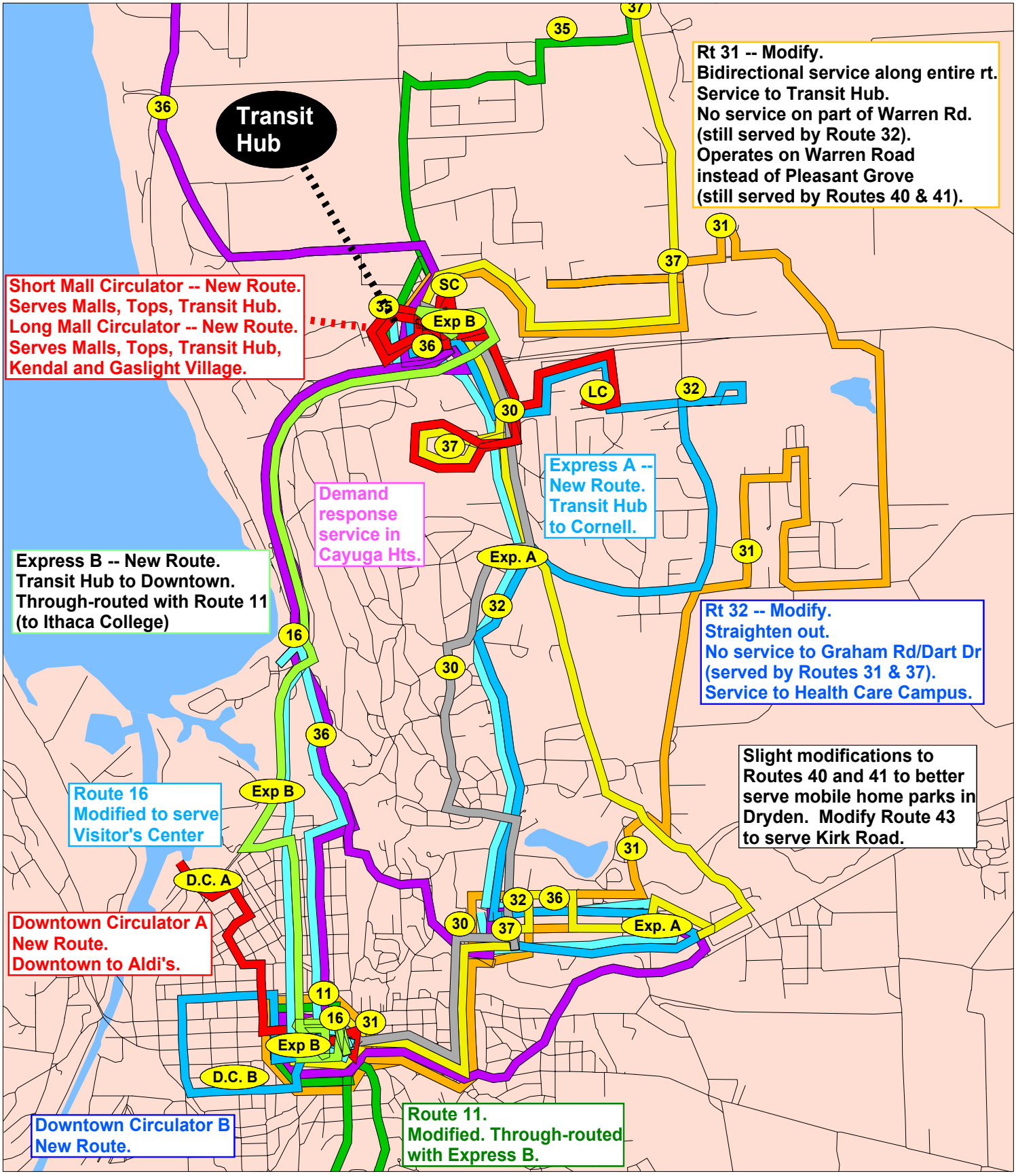
- Eliminated Route
  - Route 13

Specific details on the proposed service concepts in the southern portion of the study area are shown on Figure 1 and are described below.

- ***Express A.*** Express route A, a new route, would operate between the Pyramid transit hub and Cornell University via Triphammer Road and Thurston Avenue. This would be a frequent express service and would be scheduled to allow for convenient transfers to and from other routes at the Pyramid transit hub. Passengers would be able to park-and-ride at the Pyramid transit hub, and would have fast, direct service to Cornell. In the telephone survey, people responded positively to the concept of an express shuttle from a remote park-ride lot. People who now park in lots closer to Cornell would be the primary target market for this remote park-and-ride location.

- ***Express B.*** Express route B, a new route, would operate between the Pyramid transit hub and downtown Ithaca via State Rt. 13, Dey Street, Lincoln Street and Cayuga Street. The route could be interlined with Route 11 to provide a one-seat-ride between Pyramid Mall, Downtown and Ithaca College. Passengers could use the park-and-ride lot at the Pyramid transit hub for direct service into the downtown area (the estimated travel time is 9 minutes from the mall to downtown).

Figure 1: Proposed Service Concepts for the Southern Half of the NESTS Area



- ***Route 31.*** Route 31 would undergo significant modifications to make it more direct and offer a new connection from East Cayuga Heights to Pyramid Mall. This route currently provides service to the East Cayuga Heights neighborhood via a long one-way loop, and to the Northwood Apartments. It is proposed that the route would be extended from the Northwood Apartments to the Pyramid transit hub via Dart Drive and Graham Road (replacing service on a segment that is proposed to be removed from Route 32). Service would no longer operate along a section of Warren Road, but Route 32 would continue to operate along this segment. Service would operate in both directions along the entire length of the route (instead of the current one-way loop). Route 31 would no longer serve the Health Care Campus, which would be served by Route 32. To provide a more direct service, Route 31 would operate via Warren Road instead of via Pleasant Grove between Hanshaw Road and Forest Home Drive. (Routes 37, 40 and 41 would provide service along Pleasant Grove Road between Hanshaw and Cornell University.) Route 31 would connect to downtown Ithaca all day instead of terminating at Cornell during the midday, as it currently does.

- ***Route 32.*** It is proposed that Route 32 be simplified so that it operates directly between Sheraton Drive and the Pyramid transit hub – no longer doubling back down State Rt. 13 to Dart Drive and Graham Road prior to arriving at Pyramid Mall. (As mentioned above, Route 31 would be modified to provide service along Dart Drive and Graham Road.) This Route 32 modification would provide more direct service for many passengers to and from the Pyramid Mall area.

- ***Route 37.*** Route 37 would undergo several changes. It would be rerouted to serve the Pyramid transit hub via Dart Drive and Graham Road. It would also serve Kendal to provide direct and convenient service to Cornell for many retired and semi-retired faculty who live in Kendal. To provide more direct service between Kendal and Cornell, the route would operate via Pleasant Grove Road (it currently operates on Warren Road north of Cornell). It is proposed that this route continue to operate only during peak service hours.

- ***Downtown Circulators.*** TCAT Route 13 would be replaced by a series of three downtown circulators, and Express B. The new Downtown Circulator Route A would provide service from the downtown transfer point to Aldi's and back to the downtown transfer point. The Downtown Circulator Route B would operate as a one-way loop from the downtown transfer point, west on W. Clinton, north on N. Meadow St., east on W. Court St, south on N. Geneva, and back to the downtown transfer point. Route 16 would be slightly modified to serve the Visitor's Center, which would not be served by the proposed Downtown Circulator A, Downtown Circulator B, or Express B.

- ***Mall Circulators.*** Two new circulator routes are proposed to serve Pyramid Mall and its environs: a Long Mall Circulator and a Short Mall Circulator, both of which would be operated by small vehicles. The Short Mall Circulator would serve the Pyramid transit hub, several stops around Pyramid Mall, Tops Plaza,

and Cayuga Mall. This route would operate during busy shopping times (i.e., weekday afternoons and weekends). The Long Mall Circulator would serve all locations served by the Short Mall Circulator, and would also provide service to Triphammer Mall, Kendal and Gaslight Village. The Long Mall Circulator would operate all day on weekdays, and on weekends. In response to a comment from the Client Committee, an extension of the Long Mall Circulator to Northwood Apartments was examined. However, this would add 15 minutes to the route and thus would require a 50% increase in the number of vehicles required and operating cost and is not recommended. The altered Route 31 should provide adequate service to the retail area from Northwood Apartments.

- ***Demand-Response Service in Cayuga Heights.*** To provide a high level of transit service in the heart of the NESTS area, demand-response service is proposed to operate in Cayuga Heights and connect to Cornell. The exact routing of this service would be determined by the pattern of service requests from residents in this neighborhood.

2.2 Changes in the Northern Portion of the NESTS Area and in Dryden

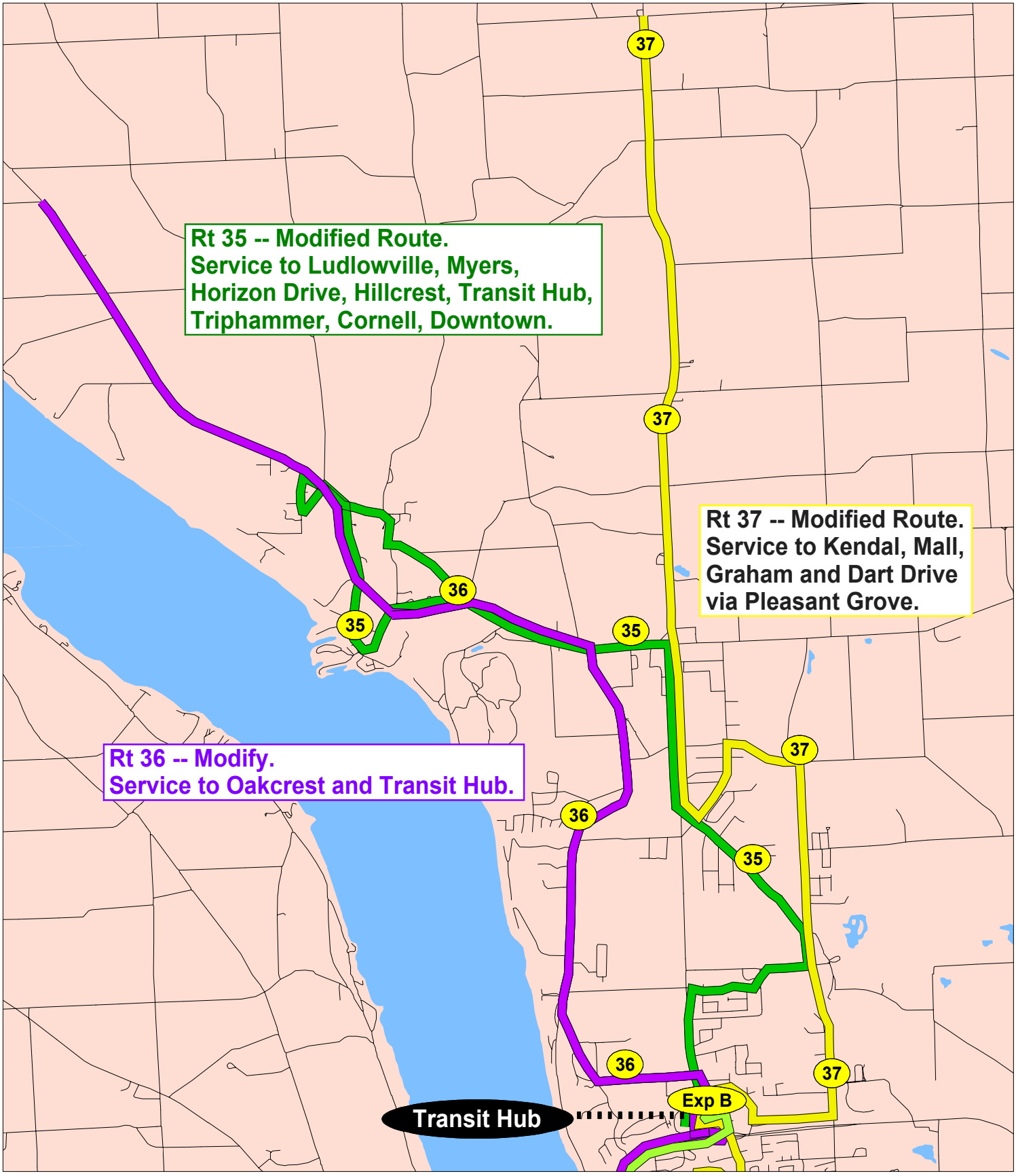
North of the Pyramid transit hub, fewer service changes are proposed. Route 37 would continue to operate in its current form (other than the diversion to the hub via Dart Drive). There would be modifications to Routes 35 and 36. Figure 2 illustrates the following proposed service concepts in the northern portion of the study area.

- ***Route 35.*** The proposed Route 35, a modification of existing Route 35, would operate between the Pyramid transit hub and the Ludlowville/Myers area via Triphammer Road, Horizon Drive, Bush Lane, Cherry Road, Warren Road and Hillcrest Road. This route would offer improved coverage of areas that do not currently have convenient service. It would also provide a higher level of service than the current Route 35.

- ***Route 36.*** Route 36 would be re-routed off State Rt. 34 to serve Oakcrest Road and the Pyramid transit hub before returning to Rt. 34 via Rt. 13. The route would not travel all the way around the mall, but only stop at the hub before continuing downtown. In the morning period, this re-route would take effect just prior to the opening of stores at the mall (i.e., not during early morning hours).

In Dryden, a slight modification of Routes 40 and 41 is proposed to provide bus service *within* the mobile home park located at the southeast corner of the intersection of Hanshaw Road & Etna Road. Routes 40 and 41, which currently travel on Hanshaw Road past this mobile home park, could be re-routed to travel into the mobile home park, via Lake Country Avenue & Schwan Drive. Also, the mobile home park located off Kirk Road does not currently receive transit service. It is proposed that Route 43 be modified, so that rather than passing Kirk Road (in the inbound direction) the bus would turn right onto Kirk Road, then left onto State Route 366 where it would continue on to Cornell. In the outbound direction, the same modification would be made.

Figure 2: Proposed Service Concepts for the Northern Half of the NESTS Area



2.3 Pyramid Transit Hub

A suburban transfer facility is proposed to be located at the Pyramid Mall. It would include an enclosed waiting area, and would serve as a convenient location for passengers to transfer between routes and services. Parking spaces for shoppers that are typically empty during 9-to-5 period on weekdays would be available for park-and-ride customers. Other passenger amenities to be available at the facility may include transit information (including real-time bus arrival information), a telephone, and vending machines.

The Pyramid Mall area was selected as the location for the proposed transit hub because it is one of the primary shopping and employment destinations in Tompkins County. Hundreds of passengers every day would not transfer at the hub, but would start or end their trip there. Being a major travel generator in its own right, Pyramid Mall is a natural location for a transit hub. Pyramid Mall also offers convenient access to State Route 13 & Triphammer Road, and includes parking that can be used by park-and-ride customers (no new parking would have to be constructed).

Figure 3 displays a transit facility located adjacent to an entrance of a shopping mall near Albany, New York. Rather than be located adjacent to a main entrance at Pyramid Mall, it is proposed that the Pyramid transit hub be constructed in the newly expanded portion of the mall lot, behind Lansing Village Place, and located south of the parking area reserved for the new Target. This location would provide for quick access to and from the suburban transit hub, as buses would use Catherwood Road and Graham Road West to access the hub. Since electric utilities are located nearby, heat and other electronic amenities (i.e., real-time information) would be easily installed.

Figure 3: Transit Center at Crossgates Mall, Albany, NY

Construction and use of the suburban transit hub is likely to benefit the Village of Lansing since it may cut down on through traffic. TCAT and Cornell would also benefit through increased bus ridership. It is recommended that TCAT be responsible for

constructing, maintaining and policing the structure at the suburban transit hub. More detail on the Pyramid transit hub is provided in Section 3.1 of this memorandum.

2.4 Improvement Scenarios Analyzed

The proposed service concepts were examined at three different levels of service: basic, enhanced, and high. Routes varied among each service level scenario in terms of hours and days of service, and service frequency.

Table 1 shows the proposed service span and headway assumptions for each affected route for all three service levels. (Headway is the number of minutes between buses on a route.) The first seven routes listed in Table 1 are new routes or services (Cayuga Heights Flexible, Express A and B, Downtown Circulators A and B, and the Long and Short Mall Circulators). Four of the remaining eleven routes are proposed to undergo significant modifications (Routes 31, 32, 35 and 37); five routes are proposed to undergo slight modifications (Routes 16, 36, 40, 41 and 43); and Routes 15 and 30 are included, which are not proposed for any modification other than a change in service span and frequency in the High scenario (Route 30), or in the Enhanced and High scenarios (Route 15).

As shown in Table 1, the span of service and frequency increase of individual routes as one moves from the Basic to the Enhanced and High scenarios. On weekdays, for example, most routes operate every 30-60 minutes in the Basic scenario, every 15-60 minutes in the Enhanced scenario, and every 10-30 minutes in the High Scenario. Some routes would operate only in certain scenarios. For example, the Cayuga Heights Circulator would operate only operate in the High scenario; Route 31 would operate on Saturdays only in the Enhanced and High Scenarios; and Route 32 would operate on Sunday only in the High Scenario. Routes 40, 42 and 43 are included in Table 1 because of the slight routing changes proposed for Dryden, but they are not assumed to change in terms of service hours or headway.

Table 2 displays the daily number of vehicle service hours that are operated currently, and the number that are assumed to be operated under the three scenarios. Under the Basic scenario, it is assumed that there will be a total of 177 vehicle hours provided each weekday by the new and modified routes, 37% more vehicle hours than are currently operated among these routes. This number increases to 260 hours in the Enhanced scenario (100% more than currently operate), and to 393 hours in the High scenario (203% more than currently operate). Similarly, Table 2 displays proposed vehicle service hour changes on Saturdays and Sundays for the three service scenarios. Total annual vehicle hours, and the percent change from current hours, is calculated assuming 257 weekdays, 52 Saturdays and 52 Sunday service days per year. Compared to current service, total annual vehicle hours is proposed to increase 39% in the Basic scenario, 102% in the Enhanced scenario, and 203% in the High Scenario.

The ridership estimation section (Section 4.0) and the Operating Cost Estimation section (Section 5.0) consider ridership and cost implications in terms of all three levels of service described.

Table 1: Proposed Service Hours and Frequencies

	Daily Hours of Service											
	Weekdays, Peak			Weekdays, Off-Peak			Saturdays			Sundays		
Route	Basic	Enhanced	High	Basic	Enhanced	High	Basic	Enhanced	High	Basic	Enhanced	High
Cayuga Heights Flexible	n/a	n/a	6	n/a	n/a	4	n/a	n/a	10	n/a	n/a	n/a
Express A	6	6	6	6	8	10	n/a	n/a	n/a	n/a	n/a	n/a
Express B	6	6	6	6	8	10	12	12	12	n/a	n/a	n/a
Downtown Circulator A	6	6	6	6	8	8	12	12	12	n/a	n/a	n/a
Downtown Circulator B	6	6	6	6	8	8	12	12	12	n/a	n/a	n/a
Long Mall Area Circulator	4	4	4	6	8	8	10	12	12	10	12	12
Short Mall Circulator	0	0	0	5	5	5	5	5	5	5	5	5
Route 15	4	4	6	10	10	10	14	14	16	9	9	9
Route 16	6	6	6	6	8	8	12	12	12	8	8	8
Route 30	6	6	6	8	8	11	17	17	17	8	8	10
Route 31	6	6	6	7	7	10	n/a	8	8	n/a	n/a	n/a
Route 32	6	6	6	10	10	10	8	8	8	n/a	n/a	8
Route 35	4	4	4	0	0	0	3	3	3	3	3	3
Route 36	2	2	4	0	0	0	n/a	n/a	n/a	n/a	n/a	n/a
Route 37	5	5	5	1	1	6	3	3	3	3	3	3
Route 40	4 runs	4 runs	4 runs	1 run	1 run	1 run	n/a	n/a	n/a	n/a	n/a	n/a
Route 41	3 runs	3 runs	3 runs	2 runs	2 runs	2 runs	n/a	n/a	n/a	n/a	n/a	n/a
Route 43	5 runs	5 runs	5 runs	2 runs	2 runs	2 runs	n/a	n/a	n/a	n/a	n/a	n/a

	Headway (minutes)											
	Weekdays, Peak			Weekdays, Off-Peak			Saturdays			Sundays		
Route	Basic	Enhanced	High	Basic	Enhanced	High	Basic	Enhanced	High	Basic	Enhanced	High
Cayuga Heights Flexible	n/a	n/a	flex	n/a	n/a	flex	n/a	n/a	flex	n/a	n/a	n/a
Express A	30	15	10	60	30	30	n/a	n/a	n/a	n/a	n/a	n/a
Express B	30	20	10	60	30	30	30	30	30	n/a	n/a	n/a
Downtown Circulator A	60	30	20	60	30	20	60	30	30	n/a	n/a	n/a
Downtown Circulator B	60	30	20	60	30	20	60	30	30	n/a	n/a	n/a
Long Mall Area Circulator	30	30	15	30	30	15	30	30	15	30	30	15
Short Mall Circulator	n/a	n/a	n/a	15	15	15	15	15	15	15	15	15
Route 15	60	30	30	60	30	30	60	30	30	60	30	30
Route 16	60	30	20	60	30	20	60	30	30	60	60	60
Route 30	30	30	20	30	30	20	30	30	20	60	60	30
Route 31	40	30	20	60	60	30	n/a	90	90	n/a	n/a	n/a
Route 32	60	30	20	60	60	30	60	60	30	n/a	n/a	60
Route 35	60	60	60	n/a	n/a	n/a	3 runs	3 runs	3 runs	3 runs	3 runs	3 runs
Route 36	30	30	30	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Route 37	60	60	30	1 run	1 run	60	3 runs	3 runs	3 runs	3 runs	3 runs	3 runs
Route 40	4 runs	4 runs	4 runs	1 run	1 run	1 run	n/a	n/a	n/a	n/a	n/a	n/a
Route 41	3 runs	3 runs	3 runs	2 runs	2 runs	2 runs	n/a	n/a	n/a	n/a	n/a	n/a
Route 43	5 runs	5 runs	5 runs	2 runs	2 runs	2 runs	n/a	n/a	n/a	n/a	n/a	n/a

Note: n/a indicates that the route does not operate on that day; 0 indicates that there is no service in that time period.

Table 2: Daily Vehicle Service Hours for Current Service and the Three Levels of Service Scenarios*

	Scenario	Vehicle Hours	% Change From Current
Weekdays (daily)	Current	130	--
	Basic	177	37%
	Enhanced	260	100%
	High	393	203%
Saturdays	Current	71	--
	Basic	101	42%
	Enhanced	137	93%
	High	188	165%
Sundays	Current	18	--
	Basic	41	125%
	Enhanced	52	184%
	High	84	359%
Annual	Current	38,049	--
	Basic	52,999	39%
	Enhanced	76,757	102%
	High	115,271	203%

*Includes: Cayuga Hts. Flexible, Downtown Circulators, Express Routes, Mall Circulators, and Routes 15, 16, 30, 31, 32, 35, 36, 37, 40, 41 and 43.

2.5 Other Potential Service Changes

The service changes described in previous pages present an enhanced transit system for the NESTS area, but they are not the last word on the subject. During Task 4 of the study, additional service concepts will be examined as they arise, and included in the final recommendations as appropriate. Two specific service ideas that came up during the production of this memorandum, but were too late to include in this analysis, were a park-and-ride lot in the State Route 79 corridor near the intersection with Pine Tree Road including new shuttle services to Cornell and downtown Ithaca, and a revision of current TCAT service to the A Lot, given the potential of diverting a significant number of people to the new Pyramid transit hub. The former has the potential of reducing traffic on Pine Tree Road and through the Forest Home neighborhood for trips destined to Cornell, and on State Street for trips destined to downtown. The latter has the potential to save some operating cost, making the proposed service enhancements more financially feasible.

3.0 Facilities

This section presents details on the design of the suburban transit hub at Pyramid Mall. It also reports the findings on the feasibilities of possible additional facilities such as signal priority systems, queue jumps and bus lanes which hold the potential to improve the efficiency of bus operations in the NESTS area. Key issues for all of these potential actions include relationships to the existing transportation system and traffic flows (the latter on both public roads and private property), community acceptance, and cost-effectiveness.

3.1 Transit Hub

3.1.1 Working Concept

As discussed in Section 2.3, Pyramid Mall was determined to be a highly desirable site for a transit hub, being both a major travel destination and a well-placed location for park-and-ride and route transfers. Discussions among the study team, TCAT and Pyramid Mall management yielded a sense of the approximate size and location of the hub on Mall grounds. Following are some details on the hub concept. A schematic diagram of the proposed hub layout will be produced during Task 4 of the the NESTS Transit Planning Project.

The transit hub is proposed to be located along the inner edge of the Pyramid Mall ring road, between the Graham Road West and Catherwood Road intersections. It is expected that the vehicles that would serve the Mall and the hub in the future would not all be the large, 40-foot buses operated today by TCAT; rather many of them (including more than half of the vehicles serving the Mall) would be 20 to 25 foot-long shuttle van-type vehicles. Nevertheless, the design of the hub is based on the standard of accommodating boarding and alighting activity related to two parked full-length buses at a time. The hub would have three entryways facing the transit vehicle staging area providing access to the inside sheltered area; the front and middle entryways approximately would line up with the locations of front bus doors when two 40' buses are parked at the hub. The remainder of the front section of the shelter would be a series of tempered glass panels, to protect transit patrons from weather and exhaust.

The length of the hub would be comparable to that of the example presented in Figures 4 and 5. (Note that the actual look of the shelter would be subject to design parameters developed by TCAT and Pyramid Mall.) While these pictures are of a shelter alongside a mall rather than a free-standing one, the physical configuration of the hub is generally comparable to that which would be desired for the Pyramid transit hub, save for greater physical segregation of the transit vehicles from ring road traffic (as will be discussed in the treatment of traffic considerations). In addition, the front end of the hub is proposed to be flush with the rest of the shelter, as in the Crossgates Mall example presented in Figure 3. This would minimize the amount of parking area needed to be taken for hub development, and maximize the ease with which transit vehicles would be able to return to the ring road from the hub parking area as they continue on their trips.

Figure 4: Off-Front View of Transit Center at Colonie Center, Albany, New York

Figure 5: Off-Rear View of Transit Center at Colonie Center, Albany, New York

As will be discussed in the review of service and logistical issues, this two bus-length transit center would be expected to accommodate the flows of transit vehicles under the proposed Mall area transit service scheme; any long vehicle layovers could be accommodated in one of a number of lightly used sections of the Mall property.

Park-and-ride spaces would be provided in the area between the transit hub and the Mall building. This area is just to the south of the parking capacity designated for the new Target store. While the entire TCAT fleet is equipped with front end-mounted bike racks, bicycle parking accommodations should still be provided at the park-and-ride lot, for bus riders who use bicycles as their access mode. Given considerations of weather and security, lockers would be preferred over racks for bicycle storage at the lot.

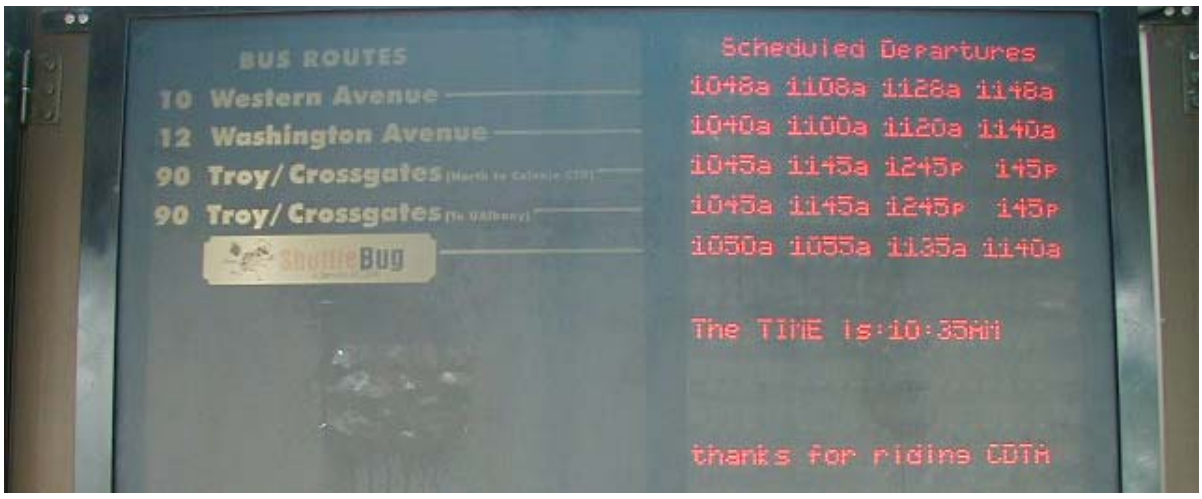
3.1.2 Required and Supplemental Treatments

Rider Amenities

Seating should be provided along the back wall of the proposed hub, in the form of a series of separate benches distributed along the length of the structure. Waste receptacles, a coin/card-operated telephone, and built-in electric space heaters and lighting should be among the minimum level of patron amenities provided at the hub.

TCAT route timetable information should be provided at the hub. As will be discussed in the section on automatic vehicle location (AVL), providing real-time arrival information at major transit stops is possible using a combination of AVL data and a "smart algorithm" to predict arrival times. TCAT has indicated a desire to develop AVL capabilities which will facilitate provision of such information to patrons at the hub; a valuable interim step would be to equip the hub with an electronic signboard such as that illustrated in Figure 6 below to provide scheduled departure information. A cellular modem-equipped signboard can minimize the level of effort required to update this information and/or advise patrons of special conditions; such signboards can usually be integrated into automated traveler information systems (including remote real-time updates) and otherwise "grow" with the technology available to TCAT at any given time.

Figure 6: Scheduled Departure Information at Transit Center



Design and Traffic-Related Treatments

These treatments address two main concerns: the need to optimize interactions between pedestrians and transit, and the need to manage interactions between hub-related traffic (pedestrian and vehicle) and Mall-related traffic.

Pedestrian-Transit Interface

Since many bus riders will have destinations in the Mall, it is anticipated that there will be significant pedestrian traffic between the hub and the Mall entrance. While the location of the hub on the inner side of the ring road minimizes overall pedestrian safety concerns, some additional treatments may be advisable. One possibility would be to paint a crosswalk or pathway from the hub to the sidewalk along the Mall building. A further measure would be to convert one half of one row of parking into a pedestrian walkway. While such an action would reduce parking capacity both for the Mall and for the potential park-and-ride customers, it would improve safety and increase the visibility of the transit hub.

Treatments Related to Traffic Considerations

- Curbing and pavement markings should clearly distinguish the ring road and transit center access areas. Motorists proceeding southbound from the Graham Road West intersection should clearly see that the transit vehicle access to the hub is not a general-use thoroughfare. These physical treatments should be complemented with a "BUSES ONLY" sign at the point at which transit vehicles would leave the ring road to access the hub.
- The access for transit vehicles to the transit hub and the length of the vehicle staging area should be curbed off to clearly segregate it from southbound ring road traffic and the adjacent parking area.
- The area in which transit vehicles will maneuver between the ring road and the transit hub structure should be at least wide enough to accommodate three buses, side-by-side, to ensure sufficient space for full-length bus maneuvers (including instances in which the rear bus leaves the hub before the front bus), maintenance vehicle maneuvers (including tow hook-ups) and personal motor vehicle clearances (in the event that motorists disregard or do not notice the "BUSES ONLY" sign).
- Traffic control at the Graham Road West and Catherwood Road intersections with the ring road should maximize the likelihood of motorists' seeing pedestrians in the crosswalk from the park-and-ride lot to the transit hub. All-way stop control at these intersections would help achieve this end; while there may be times during the December holidays at which traffic volumes entering the Mall reach levels at which stop-controlling Graham Road West and Catherwood Road could result in queuing back toward North Triphammer Road, stop-control of these two approaches should at a minimum be considered for the period outside the December holiday shopping season. Alternatively, tendencies for traffic to queue on these roads can be monitored upon the opening of the transit hub, with stop control in place, and a plan for suspending stop control of these approaches (e.g., via use of STOP signs mounted on flip-up brackets) can be established.

- The "footprint" of the transit hub will also create the need for some amount of pavement marking modification in the existing Mall lot to reflect the termination of three or four rows of parking a few spaces before the ring road. These rows could be terminated a sufficient distance from the transit hub to allow vehicles proceeding toward the ring road to turn left or right and travel parallel to the ring road until reaching a row clear of the transit hub to reach the ring road.

Service and Logistical Issues

- Transit hub maintenance, e.g., emptying wastebaskets and ensuring that the hub facilities are clean and in working order, would be the responsibility of TCAT. That said, there may be opportunities for TCAT and Pyramid Mall to negotiate an agreement for shared or "swapped" responsibility for maintenance of certain external elements of the transit hub, such as snow removal, landscaping of planted areas and roadway sweeping.

3.2 Transit Signal Priority

3.2.1 Summary of Issue and Concepts Examined

The market research study prepared by the Cornell University Computer-Assisted Survey Team for this study found that a considerable number of survey respondents pointed to a lack of predictability or reliability as the reason why they did not use transit. *Transit signal priority* is one approach to enhancing the reliability of transit service, thus holding the potential to encourage new travelers to use transit and to "expand the base" by increasing existing riders' use of transit. Signal priority can improve schedule adherence by providing transit vehicles with either an early green light or an extended green period at signalized intersections.

Transit signal priority is ordinarily *conditional*, that is, certain conditions have to be in place for transit vehicles to receive priority. The most commonly-applied conditions are the following:

- the candidate vehicle must be close enough to the signalized location for a communications link to communicate a priority request to the signal controller
- the vehicle must be late (on-time vehicles would not receive priority, as they do not need it)
- the vehicle's door must be closed (for if passengers are boarding or alighting, it is not appropriate to initiate or hold a green light)
- the direction of travel in which the vehicle is headed must not just have had a switch from a green light to a red light (for this could unsafely disrupt traffic flow)
- traffic congestion and delays do not preclude transit priority (that is, it is frequently the case that only the more congested intersections in a corridor have transit priority capability)

For this exploration, the potential to introduce signal priority capability was considered particularly for the existing signalized intersections near the Mall (and more specifically, the Route 13 ramp/North Triphammer Road intersections), other signalized intersections between the Pyramid Mall and Cornell areas, and at the unsignalized, one-lane bridges over the Fall Creek. For the bridges, the prospects for introducing signalization with either standard three-ball or single-ball "firehouse"-type signal heads were explored.

3.2.2 Findings of Signal Priority Explorations

Existing Signalized Intersections

- ***It does not appear that significant benefit would be realized from introducing priority at the two Route 13/North Triphammer Road intersections at this time.*** Priority at these two intersections by themselves (see next item) would not enhance a transit vehicle's schedule adherence unless the delays routinely experienced by transit vehicles are so severe as to arguably necessitate adjustments to the bus schedule itself.

- ***There are few if any additional locations between the Pyramid Mall and Cornell areas at which signal priority could be considered.*** There are very few signalized intersections in this area, and those intersections that are signalized tend to operate rather well, i.e., they do not impose much delay on transit vehicles.

- ***Future traffic conditions may raise opportunities for signal priority.*** Due to both increasing traffic volumes (and delays) and the potential for a small number of currently unsignalized intersections to reach traffic levels at which signalization may be warranted, the potential exists for a greater number of signals to be encountered along some of the more heavily-used TCAT routes in the future. The potential for transit priority should then be revisited.

- ***Transit signal priority may have greater potential in the downtown Ithaca area.*** The combination of sequences of signals, busy intersections and other disruptions to traffic flows—e.g., double-parking for truck unloadings—in the downtown area appears to introduce more variation to bus run times than do conditions to the north. The North Cayuga, North Tioga, West Green and West Seneca Street corridors may hold more promise for signal priority to meaningfully affect transit schedule adherence.

Unsignalized Locations (One-Lane Bridges)

- ***The bridges appear to function reasonably well without signalization.*** While signage and traffic control at the two one-lane bridges over the Fall Creek (carrying Forest Home Drive over the creek from Pleasant Grove Road to Judd Falls Road and from Warren Road to Caldwell Road) are limited to "ONE LANE BRIDGE" signs on the approaches (and, in the case of the Caldwell Road/Forest Home Drive intersection just south of one bridge, stop signs), users of the bridges appear to be familiar with the area and with what to watch for as they proceed through these areas.

- ***While significant at times, delays at the bridges are currently not unacceptable by traffic engineering standards***. While there are some waits for opportunities to proceed over the bridges, particularly during those times when significant numbers of vehicles travel either to or from the Cornell area, delays do not *currently* appear to be such that signalization would be needed to introduce more organization to traffic flows. Note that this finding does not reflect any exploration of the basic question of whether signals are currently warranted at the bridges based on traffic volume.

- ***Firehouse signals could provide a margin of safety and incorporate transit priority, but benefits would not be significant at the present time.*** Pole-mounted, single-light signals could be placed alongside the approaches to the bridges and only activate (displaying red for the approaches opposite the transit vehicles and green for the transit vehicle approaches) when a priority request is in order. The frequencies with which transit vehicles approach these bridges suggest that there would not be adverse effects on overall delays under such conditions. However, at the same time, the same comment as applied earlier to the Route 13/North Triphammer Road intersections applies here: there would not likely be a significant benefit to transit schedule adherence to be realized from a transit vehicle's getting a modest time reduction at one bridge in the course of a trip.

- ***Signalization may conflict with neighborhood preferences, and other more acceptable solutions may provide comparable benefit.*** There are indications that Forest Home Community residents may not support signalization. Absent a compelling argument for introducing signals at the bridges, other options such as improved signage to more clearly convey the desired procedure for crossing the bridges should be considered, in the interest in improving the efficiency of bridge operations in the short term.

- ***If the determination is eventually reached that either or both bridges need to be signalized, transit priority may be a reasonable "add-on" to accompany new signalization.*** Looking to the future, ITCTC TModel-based traffic forecasts show vehicle traffic increasing significantly, to the point that intersections on either end of either bridge currently operating at levels of service B to C (on an A through F scale, based on average delay) will be operating at levels of service E to F by the year 2017. Under these conditions, the benefit of transit signal priority will be even more readily apparent as compared to non-priority conditions. With bus service generally tailored to "peak" in the same direction as general traffic flow (that is, it is somewhat geared to commuter peaks as well), priority stands to benefit the majority of traffic flow on either bridge. This is noteworthy because traffic on the two bridges does have distinguishable peak directions of travel, with directional splits during the afternoon peak hour on the order of 55/45 to 60/40. If full signalization was installed for the bridges, a general improvement to the level of traffic service for all traffic could result due to the elimination of the current uncertainty regarding which vehicle has the right of way over the bridges.

3.3 Other Technologies and Accommodations

3.3.1 Automatic Vehicle Location

The potential should be explored for fast-tracking AVL deployment along Pyramid transit hub-related routes. TCAT is exploring concepts for automatic vehicle location (AVL) systems and plans to implement this technology as soon as funding and coordination issues can be worked out. As discussed previously, these systems can enhance the quality of traveler information by providing the knowledge base necessary for the generation of real-time transit information to be made available at major transit stops, including the proposed hub; in addition, this information can be made available through TCAT's web site. Once the AVL infrastructure is in place, it is strongly recommended that TCAT install real-time bus arrival information signs at all high-volume bus stops.

AVL can significantly compound the benefits of the transit hub in addressing transit patrons' need for predictable service. This investigation proceeded from the assumption that TCAT deployment of AVL will be fleetwide. That said, should there be the opportunity to fast-track deployment on particular routes – for example, in installation of the necessary on-bus components of an AVL system – those going through the Pyramid Mall hub should receive higher priority, to allow for the possibility that the hub could at its "opening day" have real-time status information available on its electronic signboard.

3.3.2 Queue Jumps

Queue jump benefits would not be expected to be significant. Queue jumps are most commonly applied to transit vehicles in conjunction with signal priority. Under such arrangements, transit vehicles would not only receive priority at a signalized intersection but would also have a short, exclusive use (i.e., "BUSES ONLY") lane to allow them to bypass waiting vehicles either when a light turns green or when a signal only applying to the buses would turn green. An alternative queue jump concept not incorporating signal priority would see an intersection approach configured with something more akin to a regular bus lane – buses would not have vehicles queued in front of them because they would have their own lane at the intersection.

Explorations of queue jump concepts considered both forms discussed above. The findings were that (1)queue jump arrangements would not be expected to provide significant additional reductions of delay to the already modest reductions attendant to signal priority and (2)bus lane configurations in themselves would not provide much benefit to transit vehicles absent priority systems. The next section discusses the specific matter of the feasibility of bus lanes.

3.3.3 Lane Use Restrictions

Opportunities for taking away or adding lanes for exclusive transit use are not sufficient to justify pursuit. Two approaches to providing transit lanes were considered:

a "take-away" basis, under which multi-lane roadways would have their outermost lanes redesignated from general use to transit-only, and the addition of new bus-only lanes. In examining the courses of the routes being reviewed or newly proposed in this effort, the findings were as follow:

- based on traffic volumes, the only possibilities for "take-aways" were along limited (i.e., not complete) stretches of some downtown streets, in some cases possibly requiring the prohibition of parking to ensure sufficient maneuvering space.
- similarly, the only possibilities for the construction of new bus-only lanes were along short-distance non-continuous sections of some roads in the northern part of the study area.

3.3.4 Automated Fare Collection

In the course of the telephone survey, respondents reacted very favorably to a concept of a "transit account" designed along the lines of the popular EZ-Pass program for highway tolls in the northeast. In this concept, the rider would carry a smart card, and each time he or she boarded a bus, the fare would be deducted from their account. When the balance in the account reached a certain level, the account would be automatically be replenished through a charge to their credit card or bank account. In this way, the passenger would never have to carry change, and they would be charged only as much as they use the bus, reducing the risk of "over-paying" for a monthly unlimited-ride pass during periods when the rider is not using the bus every day.

In order to implement such a fare program, TCAT would need to install automated fare collection equipment on all of their buses. This equipment would need to include smart card readers and communications equipment so that fare transactions could be transmitted to a central office. TCAT is already considering the purchase of such an upgraded fare system. Once the hardware is in place, it is only a matter of programming the software to allow for such an EZ-Pass type account structure.

This type of account structure is in place in Ventura County, CA, and Washington, DC. It is recommended that TCAT aggressively pursue this technology, since 43% of respondents in the survey said they would ride more often if they had such a transit account available to them.

3.3.5 Expanded Bicycle Facilities

In the discussion of the Pyramid transit hub in Section 3.1, it was noted that the proposed new hub should include bicycle storage lockers, or at least bike racks to promote bicycle access to the hub. Beyond TCAT's existing bicycles-on-buses program, additional bike storage facilities at other bus stops in the system would help to increase access to the system, thereby expanding the effective coverage area of the routes. TCAT should work with the Cornell Commuter and Parking Services office and the City of Ithaca Bicycle and Pedestrian Advisory Council to determine the best locations for new bicycle storage facilities at bus stops.

4.0 Ridership Estimation

Three approaches were used to estimate the ridership impacts of implementing the proposed service concepts detailed in Section 2 of this memorandum. The two main approaches used were an elasticity-based method and a survey-based method. A third approach, based on parking policy, was used to estimate ridership on the two proposed express routes only.

4.1 Elasticity-Based Approach

Elasticity-based approaches are often used to predict ridership responses to changes in service attributes such as frequency, travel time and service span. An elasticity is a measure of how people react to a change in what is offered to them, whether it is the price of an item or the attributes of transit service. The elasticities used in this analysis are based on industry experience over decades. Elasticities are best used to measure a reaction to small service modifications, not major route expansions or significant headway changes, and cannot be used to estimate ridership on new routes serving new geographical markets. In cases where significant service or fare changes are proposed, elasticity-based forecasts serve as lower-bound estimates because they do not capture the effect of major shift in the public's perception of service quality.

The elasticities that were used in the ridership projection formula differ depending on the type of change proposed. If the current headway (the time between successive buses on a route) on a particular route is between 10 and 50 minutes, an elasticity of -.46 was used; if the current headway is more than 50 minutes. an elasticity of -.58 was used. These differing values mean that people tend to be more sensitive to changes if the headway is currently long. For example, for a route with a 60-minute headway, an improvement to a 45-minute headway (a 25% reduction in headway) would result in approximately a 15% increase in ridership (-0.25 x -0.58 = 0.145).[1]

Since the new express routes serve the same geographical as existing routes, the elasticities can be applied to the riders on those routes who could use the express routes. Ridership was estimated using a headway elasticity and a travel time elasticity. The segment level ridership on TCAT Routes 13 and 30 was examined to determine what portion of the total ridership travelled between Pyramid Mall and either downtown Ithaca or Cornell. (Local riders on other parts of these routes would not be served by the new express routes.) This number of riders would see improved frequency and decreased travel time on the new express routes, both of which would increase the expected ridership. Riders between Pyramid Mall and Cornell would see significantly improved frequency because service on Route 30 would not be diminished in any of the proposed scenarios; thus, they would have the choice of riding Express A or Route 30.

Ridership on the downtown circulators was estimated using similar methods. The new downtown circulators serve much of the same area as part of TCAT Route 13; the

[1] Note that the elasticity formula used in the calculations is a midpoint-arc elasticity formula that is substantially more complicated than the simplified approximation shown here.

ridership on that portion of Route 13 was calculated from segment-level data and then used as the input for the elasticity formulas, given that the new circulators are proposed to have a higher level of service than Route 13. The second downtown circulator, which serves new geographic areas, was assumed to have equivalent ridership to the first downtown circulator.

For the mall circulators, there was no way to apply elasticities. Instead, a productivity was assumed based on experience at suburban malls in other places. The ridership on all of the circulator routes is likely to be extremely variable depending on the weather, the season, and the time of day.

Currently, the NESTS routes included in this elasticity-based estimate have an average weekday ridership of 3,428, an average Saturday ridership of 2,055 and an average Sunday ridership of 671[2]. The results of the elasticity-based forecast effort are shown in Table 3. As shown, based on the span and headway assumptions included in the Basic scenario[3], the forecast results in an estimated 500 additional weekday trips shifted onto transit, a 15% increase. In the Enhanced scenario, 1,100 additional weekday trips (a 31% increase) are estimated. In the High scenario, a total of 2,300 new weekday trips are estimated (a 67% increase among these routes). The table also shows estimated Saturday and Sunday ridership increases based on the assumptions set forth in each of the three scenarios.

Table 3: Elasticity-based Forecast

	Basic	Enhanced	High
Weekday New Trips	500	1,100	2,300
Saturday New Trips	200	400	1,000
Sunday New Trips	0	30	300
Weekday Pct. Increase	14%	31%	67%
Saturday Pct. Increase	7%	20%	48%
Sunday Pct. Increase	0%	4%	47%

4.2 Survey-Based Approach

The second approach was based on the results of the 500-household telephone survey that was performed by the Computer Assisted Survey Team of Cornell University in Task 1 of this study. The survey revealed a willingness among many non-riders to use an improved transit service, with 59% of non-users stating that they would consider using an improved transit system for some of their transportation needs if the service was easy-to-use, convenient, inexpensive, and if information about using it were readily available. Among the 59% who said that they'd consider using it, over 73% said they would use the service only occasionally, while 27% said they would use it for most or all of their trips. Based on these stated usage frequencies, it was calculated that on any given day, about 12% of non-riders would use an enhanced transit system (provided that the enhancements met their understanding of the terms "easy-to-use, convenient", etc.).

[2] Includes routes 13, 15, 16, 30, 31, 32, 35, 36 and 37.
[3] See Table 1 for detailed service span and headway assumptions for every route for each scenario.

It is assumed, however, that the results of this type of general public telephone survey reflects a built-in bias because many survey respondents overstate their intentions to use transit, since they are not obligated to carry out their stated intention. Therefore, to correct for the resulting overstated potential use, the 12% of non-riders who stated that they would use transit on any given day had to be discounted further through a "non-commitment bias" correction. The source for the proper non-commitment bias correction factors was a 1983 study by Chatterjee, Wegmann, and McAdams.

The 1983 study found that the degree to which people overstated their willingness to use a new transit service depended on how many vehicles were owned by their household and their age. The results of their analysis provided a series of factors for elderly and non-elderly respondents with zero vehicles, one vehicle, or two or more vehicles. The telephone survey provides information on whether each respondent was elderly or not, and how many vehicles were owned by their household. These responses allowed us to apply the proper non-commitment bias factor to each survey record.

The result of these bias correction calculations is that only 4.4% of *non-riders* in the study area can be expected to use an improved transit system on any given day. It was also calculated by a similar method that 3.6% of *current riders* would make additional trips on any given day. Together, these factors were used to calculate the number of new trips shown in Table 4.

While 4.4% of non-riders would use a convenient, easy-to-use (etc.) transit system on any given day, it is assumed that in the Basic scenario, only 20% of non-users would consider the system to fit that description. This number is assumed to increase to 40% given the span, headway and services of the Enhanced scenario. In the High scenario, it is assumed that 80% of non-users would consider the services offered to be easy-to-use, convenient, etc. Thus, in the survey-based ridership estimation approach, as routes and services are further enhanced, the number of potential riders increases.

As shown in Table 4, the estimated number of new trips on an average weekday based on the survey-based approach ranges between 900 (in the Basic scenario) and 3,600 (in the High scenario). These estimates, 60-80% higher than the ridership based on the elasticity-based approach, can be considered the upper-bound estimates.

Table 4: Survey-based Forecast

	Basic	Enhanced	High
Weekday New Trips	900	1,800	3,900
Increase over Existing	26%	53%	105%

4.3 Policy-Based Approach

In addition to the elasticity-based and survey-based approaches, a third approach, based on policy changes, was used to estimate ridership on the two new proposed express routes. Express A would provide frequent service between the Pyramid transit hub and Cornell University, and Express B would provide frequent service between the hub and downtown Ithaca.

This policy-based survey approach began by estimating the number of people who make trips within the catchment area of each route (between the Town or Village Lansing and Cornell for Express A, and between the Town or Village of Lansing and Downtown Ithaca for Express B). These estimates were based on a "select link analysis" of data from the ITCTC regional model, which summarizes automobile travel between all origins and destinations.

It is assumed that persons living in the Lansing area and traveling to Cornell or downtown Ithaca are price-sensitive, and may change their travel mode based on parking prices at Cornell or downtown. It is also assumed that no parking fees would ever be imposed at the Pyramid Mall, or elsewhere in the Town or Village of Lansing, so those persons living downtown or near Cornell and traveling on an express route to the Pyramid Mall (the "reverse" direction) do not make travel decisions based on the cost of parking in Lansing. Two markets, therefore, were created to estimate demand on the express routes: those "inbound commuters", affected by parking price increases at Cornell and Downtown Ithaca, and those "reverse commuters" or "shoppers", unaffected by parking prices in Lansing.

According to the regional model, roughly 570 persons live at Cornell and travel to the Pyramid Mall on an average weekday – either as shoppers or employees at the mall. (This is the market that is unaffected by parking prices). Among these, the survey results indicate that 3.7% of non-users would use an express bus, resulting in a potential pool of 21 "reverse commuters" who may use an express bus that they consider to be convenient, easy-to-use, and inexpensive. The inbound commuter market is the larger of the two markets. It is estimated that 3,610 people live in the catchment area (the Town and Village of Lansing) and work or go to school at Cornell on an average weekday. These 3,610 people are assumed to be sensitive to the price of parking at their work/school location. In the telephone survey, the following question was asked:

"Assuming that you could park for free at a remote lot and have an express shuttle to your destination, how much would the daily charge for parking at your destination have to increase to get you to become a regular transit user?"

Because Cornell offers only permit parking, the price of parking at Cornell varies depending on the location and on how many days the person parks. For Fall 2002, a new student parking every day during the academic year (assuming 172 weekdays for weeks when school is in session) would pay $3.32 per day. Faculty and staff parking on the main campus will pay up to $2.50 per day (assuming that they park 250 days during the year—if they park fewer days, the average daily cost would be higher).

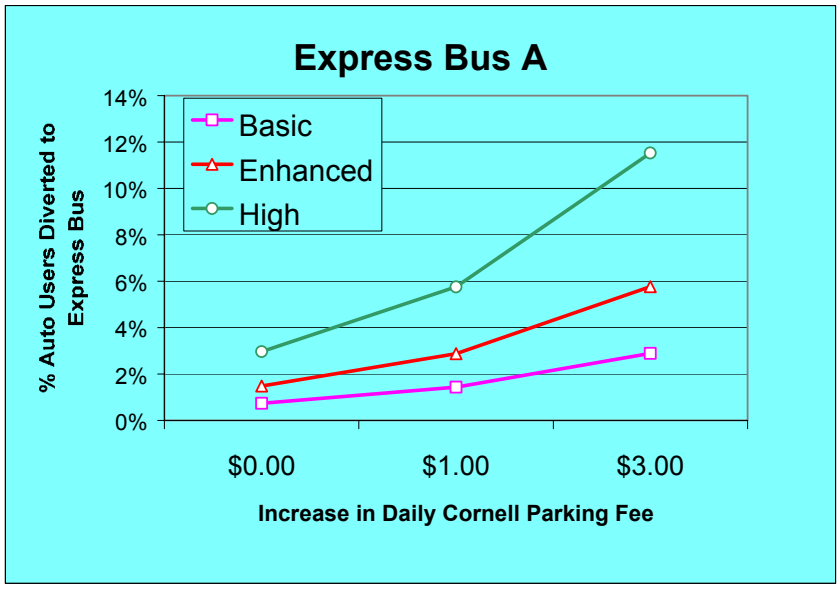
According to the survey and assuming the same non-commitment bias that was described in the survey-based approach above, it is estimated that 3.7% of non-users would use a park-and-ride lot/ express bus even if parking costs at their destination do not increase. A total of 7.7% of non-users would use a park-and-ride lot/express bus if the parking price at their destination increased by $1.00 per day. Finally, 16.1% of non-users would use a park-and-ride lot/ express bus if the parking price at their destination increased by $3.00 per day.

Assuming that each potential passenger makes an average of 2 one-way trips each weekday, the pool of potential users for Express A to Cornell ranges from 310 (no increase in parking fee) to 1,205 ($3 increase in parking fee). However, as was the case with the survey-based approach, it is assumed that in the Basic scenario, only 20% of non-users would consider Express A to be convenient, easy-to-use, etc. This number increases to 40% in the Enhanced scenario and to 80% in the High scenario. Figure 7 displays the resulting ridership forecast for Express A, based on three pricing levels.

As shown, under the Basic scenario, the number of trips per day is estimated to be 62 if there is no parking fee increase. This represents a 0.7% *mode shift* – 31 people would switch from their private vehicle to use the Express A bus. If parking increases by up to $1.00 per day, and the Enhanced level of service is offered on Express A, it is assumed that 240 trips would occur on an average weekday, representing a 2.9% *mode shift* among people traveling between Cornell and the Pyramid Mall. If parking fees at Cornell increase by $3.00 per day and the High level of service is offered on Express A, it is estimated that 964 trips would occur on an average weekday, representing 482 people switching from their cars and onto transit, an 11.5% mode shift. Figure 7 also graphically illustrates the ridership estimates for the Express A route, considering different pricing and level-of-service decisions. A large majority of these trips would be in the peak direction, with only a handful of reverse commuters.

Figure 7: Policy-based ridership forecast for Express A

Daily Parking Fee Increase	Basic		Enhanced		High	
	Shift	*Trips*	*Shift*	*Trips*	*Shift*	*Trips*
$0	0.7%	(62)	1.5%	(124)	3.0%	(248)
$1	1.4%	(120)	2.9%	(240)	5.8%	(481)
$3	2.9%	(241)	5.8%	(482)	11.5%	(964)

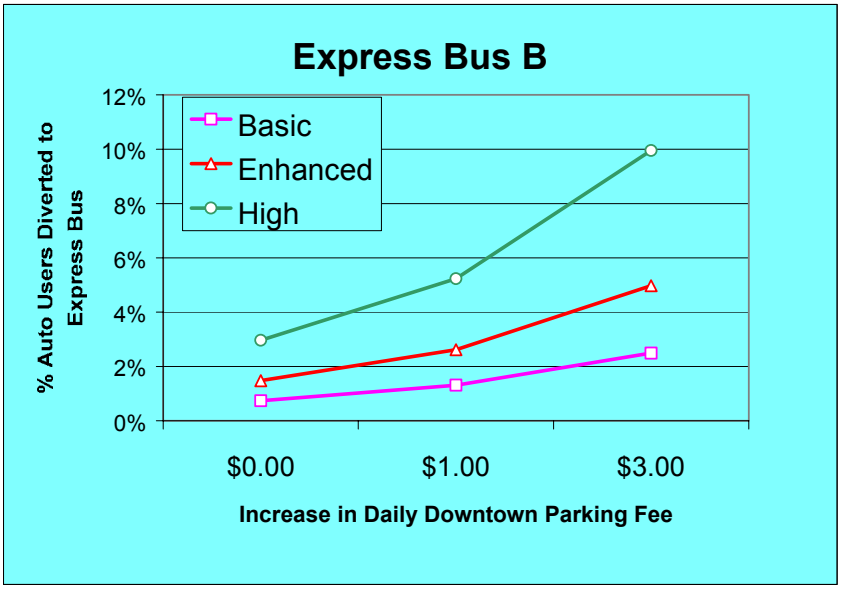


An identical method was used to estimate ridership on Express B based on parking fee changes in Downtown Ithaca. As a point of reference, the current price for parking downtown in the Green Street and Seneca Street garages is $30/month (upper levels) or $50/month (lower levels). The monthly charge is $40 at the D Lot. The three lots charge an hourly fee of 50¢, with the first two hours free (so, for example, there would be no charge for parking for 1.5 hours; a 50¢ charge for parking for 2.5 hours, and a $3.00 charge for parking for 8 hours).

As shown in Figure 8, under the Basic scenario, the number of trips between the suburban transit facility and Downtown Ithaca on Express B is estimated to be 75 per day if there is no parking fee increase. This represents a 0.7% *mode shift*. If parking increases by $1.00 per day, and the Enhanced level-of-service is offered on Express B, it is assumed that 265 trips would occur on an average weekday, representing a 2.6% mode shift among people traveling between Downtown Ithaca and the Town/Village of Lansing. Under the most optimistic of all conditions, if parking fees Downtown increase by $3 per day and the High level-of-service is offered on Express B, it is estimated that 1,009 trips would occur on an average weekday, representing about 505 people switching from their cars and onto transit, a 10% mode shift. Again, the bulk of these trips would be in the peak direction, with only a handful of reverse commuters. Figure 8 graphically illustrates the ridership estimates for the Express B route, considering different pricing and level-of-service decisions.

Figure 8: Policy-based ridership forecast for Express B

Daily Parking Fee Increase	Basic		Enhanced		High	
	Shift	*Trips*	*Shift*	*Trips*	*Shift*	*Trips*
$0	0.7%	(75)	1.5%	(150)	3.0%	(301)
$1	1.3%	(133)	2.6%	(265)	5.2%	(531)
$3	2.5%	(252)	5.0%	(504)	10.0%	(1,009)



5.0 Operating Cost Estimation

The first step to estimate operating costs associated with the potential service changes was to measure the length of each proposed route. Then, a speed was selected for each route, based on current operating speeds, and an estimated running time was calculated. Recovery time[4] was added for each route, and a proposed cycle time was calculated. Next, service span and headway information for each route (as was previously shown in Table 1 of this report) was used to calculate the number of vehicles and vehicle hours that would be required to supply service along each route.

This procedure was carried out for peak, off-peak, Saturday and Sunday hours. Once the procedure was completed for each of the four time periods, the total annual vehicle revenue hours were calculated[5]. Finally, TCAT's current marginal cost per revenue hour[6] was multiplied by the change in annual revenue hours for each route to calculate the change in annual operating cost by route. It is important to note that by using the marginal cost, there is an implicit assumption that there would not be a need for new maintenance facilities or administrative staff as a result of these service changes.

Costs associated with all new and modified routes were combined, and costs associated with any deleted routes were subtracted to generate the total annual operating cost change for each of the three service scenarios (Basic, Enhanced and High). Table 5 displays the *additional* operating costs associated with each of the three service scenarios as well as the current operating costs (assuming the same marginal cost rate) associated with all affected routes in the study area (Routes 13, 15, 16, 30, 31, 32, 35, 36, 37, 40, 41, and 43).

As shown in Table 5, the Basic scenario is estimated to cost about $504,000 (34%) more than the cost of current services. The Enhanced scenario is estimated to cost $1,215,000 (83%) more than current services. Finally, the High scenario is the most expensive, costing $2,863,000 (196%) more than current services.

Table 5: Estimated Operating Cost of Proposed Services (in thousands)

Route Type	Current Operating Cost*	Additional Operating Cost		
		Basic	Enhanced	High
New Routes	$0	$329	$596	$1,121
Modified Routes	$1,461	$175	$619	$1,743
Total	$1,461	$504	$1,215	$2,863
Additional % Increase	--	34%	83%	196%

*Includes routes 13, 15, 16, 30, 31, 32, 35, 36, 37, 40, 41 and 43

[4] Recovery time was estimated to be no more than 20% of running time
[5] Assumed that vehicles would operate 257 weekdays, 52 Saturdays and 52 Sundays per year.
[6] $38.25 per hour on fixed bus routes; $30.00 per hour for demand-responsive services.

6.0 Capital Cost Estimation

In the previous sections of this memorandum, a number of capital items were mentioned that would be part of an enhanced transit system for the NESTS area. This section provides some preliminary estimates for the costs of these capital items. The costs will be examined in more detail in Task 4 of the NESTS Transit Planning Project.

The two items with the largest capital cost that are specifically included as potential recommendations of the NTPP are the new vehicles needed to operated the expanded service, and the proposed new transit hub at Pyramid Mall. Costs for other items that TCAT is already in the process of procuring, such as an AVL system for all of their buses and an automated fare collection system, are not included here. In addition, total costs for new bus shelters, passenger information systems, and transit signal priority systems are not provided, since the number of applications of these capital improvements has not been determined. Some unit costs are provided below.

The three levels of service at which the proposed service can be operated require different numbers of vehicles. The vehicle requirements and associated costs are shown below in Table 6. The number of vehicles are based on the peak requirement, which takes place during the afternoon rush hour, and are net figures, assuming that buses currently used on services to be eliminated would be used on the new services. The unit costs are based on the current TIP for the Ithaca area. All buses would be low-floor vehicles.

Table 6: Estimated Vehicle Requirements and Capital Costs

Type of Vehicle	Unit Cost	Net Number of New Vehicles Needed		
		Basic	Enhanced	High
Full size buses	$260,000	0	2	9
Small buses	$125,000	6	8	12
Demand-response	$50,000	0	0	1
TOTAL COST		$ 750,000	$ 1,520,000	$ 3,890,000

The initial cost estimate for the suburban transit hub at Pyramid Mall is in the range of $50,000. This cost includes the structure and basic signage and landscaping, but does not include the full array of amenities that would be desirable in the long term. Some of those amenities (e.g. real-time arrival information) could be included in different line items in the TCAT budget (such as for a systemwide upgrade of passenger information). These costs and the funding possibilities will be examined in more detail in Task 4.

Transit signal priority at an intersection can cost anywhere from $2,500 to $18,000 depending on the complexity of the intersection and the type of equipment used. These figures assume that the intersection is already signalized. To install new “firehouse” signals at the one lane bridges, an additional cost of $25,000 to $50,000 could be expected.